OIL AND GREASE TREATMENT USING INDIGENOUS BACTERIAL BIOFILM SYSTEM

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Specially dedicated to my beloved

Family, Lecturers and Friends

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ABSTRACT

The Malaysian palm oil industry grows rapidly as the premier agriculture-based industry over the last two decades. However, the production of palm oil also resulted in the generation of large quantities of polluted wastewater commonly referred to as palm oil mill effluent (POME) as well as lignocellulosic biomass, especially from fronds, trunks, empty fruit bunch, palm kernel and mesocarp fibre. This study evaluates on the potential application of an immobilized bacterial-based system to reduce oil and grease (O&G) contamination in POME. From the 21 bacterial isolates, two isolates (i.e. isolate X7 and X10) were chosen for subsequent studies based on its high cell surface hydrophobicity, opaque halo formation and high culture turbidity. The bacterial isolates were evaluated for O&G degradation ability by varying contact time, initial POME concentration and initial pH. The isolated X10 showed the ability to completely degrade O&G from POME after 6 days of incubation at 200 rpm, 30^{o}C and pH 7 in the batch study. In the continuous flow-through column study, oil palm frond (OPF) - immobilized isolate X7 showed complete O&G degradation and 92.59% of chemical oxygen demand (COD) degradation from 100% (v/v) POME used after 8 days of contact time. Scanning Electron Microscope examination showed the presence of diverse morphology of microorganisms indicating the formation of mature biofilm after 200 days. One of the bacterial species isolated from the biofilm was identified as *Bacillus cereus* in whichmatch up to 99% of the query sequence. The finding of this study indicates the potential of using indigenous aerobic bacterial isolates as an alternative solution to degrade O&G in POME wastewaters.

ABSTRAK

Industri minyak sawit Malaysia berkembang dengan pesat sebagai industri berasaskan pertanian yang terulung sejak dua dekad yang lalu. Walau bagaimanapun, pemprosesan minyak kelapa sawit juga menyebabkan penghasilan kuantiti air sisa tercemar yang banyak, seringkali dirujuk sebagai buangan air sisa kilang minyak sawit (POME) atau dikenali sebagai biojisim lignoselulosik,khususnya pelepah, batang, buah tandan kosong, isirong sawit dan gentian mesokarp. Kajian ini memberi tumpuan terhadap penilaian potensi sistem bakteria tersekat gerak untuk mengurangkan pencemaran minyak dan gris (O&G) dalam POME. Berdasarkan 21 pencilan bakteria awal, dua pencilan bakteria (iaitu pencilan X7 dan X10) telah dipilih untuk kajian selanjutnya berdasarkan nilai yang tinggi bagi permukaan sel, formasi halo legap dan nilai kekeruhan kultur. Pencilan bakteria telah dinilai bagi keupayaan menguraikan O&G dengan mempelbagaikan masa tindakbalas, kepekatan asal POME dan pH asal. Pencilan X10 menunjukkan keupayaan untuk mendegradasi secara lengkap O&G dari POME selepas tempoh pengeraman selama 6 hari pada 200 rpm, 30^{o}C dan pH 7 menerusi kajian kelompok. Bagi kajian menggunakan aliran turus yang berterusan, pencilan X7 yang tersekat gerak pada pelepah kelapa sawit (OPF) menunjukkan keupayaan untuk mendegradasi secara lengkap O&G dan degradasi keperluan oksigen kimia (COD) pada tahap 92.59% daripada 100% (v/v) POME yang digunakan selepas 8 hari masa tindakbalas. Analisis mikroskop elektron pengimbas menunjukkan kehadiran morfologi pelbagai jenis mikroorganisma yang menandakan pembentukan biofilem matang selepas 200 hari. Salah satu daripada spesis bakteria yang diasingkan daripada biofilem telah dikenalpasti sebagai *Bacillus cereus* dengan nilai padanan setinggi 99%. Hasil daripada kajian ini menunjukkan potensi penggunaan pencilan bakteria indigenus aerobik sebagai penyelesaian alternatif untuk menguraikan O&G dalam air sisa buangan POME.